Decision Rationale

Total Maximum Daily Load of
Fecal Coliform for Dry River

I. Introduction

This document will set forth the Environmental Protection Agency's (EPA) rationale for approving the Total Maximum Daily Load (TMDL) of Fecal Coliform for the Dry River submitted for final Agency review on January 04, 2001. Our rationale is based on the TMDL submittal document to determine if the TMDL meets the following 8 regulatory conditions pursuant to 40 CFR §130.

1. The TMDLs are designed to implement applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. The TMDLs have been subject to public participation.
8. There is reasonable assurance that the TMDLs can be met.

II. Background

Located in Rockingham County, Virginia, the overall Dry River watershed is approximately 56,800 acres (not including the Muddy Creek watershed). The TMDL addresses 6.47 miles of Dry River from the Rte. 613 bridge in Lilly to its confluence with the North River. Forest is the predominant land use in the watershed. However, agriculture is the dominant land use in the impaired segment. Dry River is a tributary to the North River which flows into the S.F. Shenandoah, which flows into the Potomac, which discharges to the Chesapeake Bay.

In response to Section 303 (d) of the Clean Water Act (CWA), the Virginia Department of Environmental Quality (VADEQ) listed 6.47 miles of Dry River as being impaired by elevated levels of fecal coliform on Virginia's 1998 303 (d) list. Dry River was listed for violations of Virginia's fecal coliform bacteria standard for primary contact. The impaired segment of Dry River is referred to as the lower Dry River. Fecal Coliform is a bacterium which can be found within the intestinal tract of all warm blooded animals. Fecal coliform can therefore be found in the fecal wastes of warm blooded animals. Fecal coliform in itself is not a pathogenic organism. However, fecal coliform indicates the presence of fecal wastes and the potential for the existence of other pathogenic bacteria. The higher concentrations of fecal coliform indicate the elevated likelihood of increased pathogenic organisms. Dry River, identified as watershed VAV-B21R, was given a high priority for TMDL development. Section

303 (d) of the Clean Water Act and its implementing regulations require a TMDL to be developed for those waterbodies identified as impaired by the State where technology-based and other controls do not provide for the attainment of Water Quality Standards. The TMDL submitted by Virginia is designed to determine the acceptable load of fecal coliform which can be delivered to Dry River, as demonstrated by the Hydrologic Simulation Program Fortran (HSPF)[1], in order to ensure that the water quality standard is attained and maintained. These levels of fecal coliform will ensure that the Primary Contact usage is supported. HSPF is considered an appropriate model to analyze this watershed because of its dynamic ability to simulate both watershed loading and receiving water quality over a wide range of conditions.

The TMDL analysis allocates the application/deposition of fecal coliform to land based and instream sources. For land based sources the HSPF model accounts for the buildup and washoff of pollutants from these areas. Build up (accumulation) refers to all of the complex spectrum of dry-weather processes that deposit or remove pollutants between storms. Washoff is the removal of fecal coliform which occurs as a result of runoff associated with storm events. These two processes allow the HSPF model to determine the amount of fecal coliform from land based sources which is reaching the stream. Point sources and wastes deposited directly to the stream were treated as direct deposits. These wastes did not need a transport mechanism to allow them to reach the stream. The allocation plan calls for the reduction in fecal coliform wastes delivered by cattle in-stream and milking parlor washoff.

Table #1 summarizes the specific elements of the TMDL.

Parameter	TMDL(cfu/yr)	WLA(cfu/yr)	LA(cfu/yr)	MOS^1 (cfu/yr)
Fecal Coliform	3.94 x 10^{14}	0.003 x 10^{14}	3.74 x 10^{14}	0.1974 x 10^{14}

1 Virginia includes an explicit MOS by identifying the TMDL target as achieving the total fecal coliform water quality concentration of 190 cfu/100ml as opposed to the WQS of 200 cfu/ml. This can be viewed explicitly as a 5% MOS.

EPA believes it is important to recognize the conceptual difference between directly deposited loads (loads deposited to the stream) and land applied loads. Directly deposited loads represent the actual amount of fecal coliform being deposited into the stream segments. While values for flux sources (land applied sources) represent the amount of fecal coliform deposited to land (Table 4-13, in the report). The actual amount of fecal coliform which reaches the stream will be less than the amount of fecal coliform deposited to land due to die-off, geography (distance to the stream), soil, and application method. The HSPF model, which considers landscape processes which affect the total amount of fecal coliform runoff form land uses, determines the amount of fecal coliform which will reach the stream segment. Table 6.3 of the

[1]Bicknell, B.R., J.C. Imhoff, J.L. Little, and R.C. Johanson. 1993. Hydrologic Simulation Program-FORTRAN (HSPF): User's Manual for release 10.0. EPA 600/3-84-066. U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

TMDL report illustrates the actual amounts of fecal coliform being transported to Dry River.

The United States Fish and Wildlife Service has been provided with a copy of this TMDL.

III. Discussion of Regulatory Conditions

EPA finds that Virginia has provided sufficient information to meet all of the 8 basic requirements for establishing a fecal coliform TMDL for Dry River. EPA is therefore approving this TMDL. Our approval is outlined according to the regulatory requirements listed below.

1) The TMDL is designed to meet the applicable water quality standards.

Virginia has indicated that excessive levels of fecal coliform due to nonpoint sources (directly deposited into the River) have caused violations of the water quality standards and designated uses on the Dry River. The water quality criterion for fecal coliform is a geometric mean 200 cfu (colony forming units)/100ml or an instantaneous concentration of no more than 1,000 cfu/100ml. Two or more samples over a thirty-day period are required for the geometric mean standard. Therefore, most violations of the State's water quality standard are due to violations of the instantaneous standard.

The HSPF model was used to determine the fecal coliform deposition rates to the land as well as loadings to the stream form point and direct deposition sources necessary to support the fecal coliform water quality criterion and primary contact use. The following discussion is intended to describe how controls on the loading of fecal coliform to Dry River will ensure that the criterion is attained.

The TMDL modelers determined the fecal coliform production rates within the watershed. Information was attained from a wide array of sources on the farm practices in the area (land application rates of manure), the amount and concentration of farm animals, point sources in the watershed, animal access to the stream, wildlife in the watershed and their fecal production rates, land uses, weather, stream geometry, etc. This information was put into the model. The model then combines all the data to determine the hydrology and water quality of the stream.

The hydrology component of the model for all the North River TMDLs (Pleasant Run, Mill Creek, and Dry River) was developed on Linville Creek using flow data from 1991 through 1996 and then transferred to each individual watershed. This was done because there were no stream gages on the other waters. When the simulated data on Linville accurately reflected the observed flow data the model was considered complete and transferred to the other watersheds. To verify the transferability of the model, the model was run on Muddy Creek and Linville Creek (flow data from 1986 to 1991). The percent error between observed and simulated flows for both validation runs were within the desired criterion of 10%. The winter simulated flow for Muddy Creek was significantly greater (above the 10% desired range) than the observed flow. This may have been caused by a combination of the unusual weather patterns exhibited during the winters of 1994 and 1995 and the short duration of the validation period. The hydrologic

parameters were adjusted to match the conditions in each watershed. The model was calibrated by comparing simulated flow results to observed flows (monthly samples).

When the model was transferred to the Dry River watershed, it was discovered (through a comparison of observed versus simulated data) that the model over represented low flows. Therefore several of the parameters, where changed to address the differences between the Dry River and Linville Creek watersheds. Increases were made to several of the parameters including those for infiltration capacity, flow to deep groundwater, and lower zone nominal storage. These parameters helped reduce the simulated flows in the Dry River in order for it to coincide with observed data.

EPA believes that using HSPF to model and allocate fecal coliform will ensure that the designated uses and water quality standards will be attained and maintained for Dry River.

2) The TMDL includes a total allowable load as well as individual waste load allocations and load allocations.

Total Allowable Loads

Virginia indicates that the total allowable loading of fecal coliform is the sum of the loads allocated to land base, precipitation driven nonpoint source areas (cropland, pasture (1, 2, and 3), loafing lots, rural residential, forest) from flux sources, directly deposited nonpoint sources of fecal coliform (cattle in-stream, wildlife in-stream, and milking parlor wash-off), and point sources (Wampler Foods, Muddy Creek Watershed). Activities such as the application of manure, fertilizer, and the direct deposition of wastes from grazing animals are considered fluxes to the land use categories. The actual value for the total fecal load can be found in Table 1 of this document. The total allowable load is calculated on an annual basis due to the nature of HSPF model.

Muddy Creek is a tributary to Dry River. Based on current conditions, over 60% of Dry River's fecal coliform load is delivered by Muddy Creek. In 1999, EPA approved the Muddy Creek Fecal Coliform TMDL. When determining the allocation plans for Dry River, it was assumed that the fecal coliform reductions for Muddy Creek had taken place. Muddy Creek was modeled as point source using data from the Muddy Creek TMDL. In order for Dry River to attain and maintain standards, the Muddy Creek TMDL must be implemented.

Waste Load Allocations

There are no point sources on Dry River itself. However, Wampler Foods does discharge to Muddy Creek. The load from this facility was considered in the TMDL equation. Based on the VPDES permit it was assumed that the load from WFI was 0.30 x 10^12 cfu per year. The actual load from WFI may in fact be quiet less, due to Wampler's current treatment system.

Table 2 - Summarizes the WLAs for each point source

Point Source Name	Existing Load(cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction
Wampler Foods (WFI)	0.30E+12	0.3E+12	0%

Load Allocations

According to federal regulations at 40 CFR 130.2 (g), load allocations are best estimates of the loading, which may range form reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading. Wherever possible natural and nonpoint source loads should be distinguished.

In order to accurately simulate landscape processes and nonpoint source loadings, VADEQ used the HSPF model to represent the Dry River watershed. The HSPF model is a comprehensive modeling system for simulation of watershed hydrology, point and nonpoint loadings, and receiving water quality for conventional pollutants and toxicants[2]. More specifically HSPF uses precipitation data for continuous and storm even simulation to determine total fecal loading to Dry River from impervious areas, cropland, forest, pasture (1, 2, and 3) loafing lots, rural residential, farmstead. The total land loading of fecal coliform is the result of the application of manure (cattle and poultry wastes), direct deposition from cattle and wildlife (geese, duck, racoon, muskrat, and deer) to the land, fecal coliform production from dogs, and septic system failure.

In addition, VADEQ recognizes the significant loading of fecal coliform from cattle in-stream, wildlife in-stream, and milking parlor wash-off. These sources are not dependent on a transport mechanism to reach a surface waterbody and therefore impact water quality during low and high flow events. These sources were modeled as though they were point sources, loads from the upper Dry River and Muddy Creek were modeled the same way.

Climatic data was obtained from the dale Enterprise weather station. This weather station is located 4.6 miles from the watershed outlet. Precipitation acts as a transport mechanism for land applied loads. Therefore, weather data plays an integral part in the modeling process, affecting the loading to the stream.

Table 3 - Load allocation for the land application of fecal coliform

Source	Existing Load (cfu/yr)	Allocated Load(cfu/yr)	Percent Reduction

[2] Supra, footnote 2.

Cropland	67.5E+12	67.5E+12	0%
Pasture 1	119.9E+12	119.9E+12	0%
Pasture 2	14.7E+12	14.7E+09	0%
Pasture 3	111.7E+12	111.7E+12	0%
Loafing Lots	2.1E+12	2.1E+12	0%
Rural Residential	8.6E+12	8.6E+12	0%
Farmstead	5.3E+12	5.3E+12	0%
Forest	3.9E+12	3.9E+12	0%
Wildlife In-Stream	2.4E+12	2.4E+12	0%

Milking Parlor Wash-Off	1.1E+12	0.0	100%
Cattle In-Stream	182.4E+12	29.2E+12	84%

3) The TMDL considers the impacts of background pollution.

The Dry River TMDL considered background as being pristine forested conditions. The loading from this environment was determined to be 30 cfu/100ml. Wildlife was the source of fecal loading for background conditions. This load was modeled as a point source from the upper Dry River. Muddy Creek was also modeled as a point source load to the lower Dry River as well.

4) The TMDL considers critical environmental conditions.

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of Dry River is protected during times when it is most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[3]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence but when modeled to, insure that water quality standards will be met for the remainder of conditions. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable "worst-case" scenario condition. For example, stream analysis often uses a low-flow (7Q10) design condition because the ability of the waterbody to assimilate pollutants without exhibiting adverse impacts is at a minimum.

The sources of bacteria for these stream segments were mixtures of dry and wet weather driven sources. Low flow events represent the critical condition for Dry River.

---

[3]EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

5) The TMDLs consider seasonal environmental variations.

Seasonal variations involve changes in stream flow as a result of hydrologic and climatological patterns. In the continental United States, seasonally high flow normally occurs during the colder period of winter and in early spring from snow melt and spring rain, while seasonally low flow typically occurs during the warmer summer and early fall drought periods. Consistent with our discussion regarding critical conditions, the HSPF model and TMDL analysis effectively considered seasonal environmental variations. The TMDL clearly considered seasonal environmental variations as the model for Dry River was run from 1993 through 1996.

6) The TMDLs include a margin of safety.

This requirement is intended to add a level of safety to the modeling process to account for any uncertainty. Margins of safety may be implicit, built into the modeling process by using conservative modeling assumptions, or explicit, taken as a percentage of the wasteload allocation, load allocation, or TMDL.

Virginia used an explicit margin of safety by establishing the TMDL target water quality concentration for fecal coliform at 190 cfu/ 100mL, which is more stringent than Virginia's water quality standard of 200 cfu/100 mL.

7) The TMDLs have been subject to public participation.

This TMDL was subject to a number of public meetings. Three public meetings were held in Dayton, VA. The meeting were held on December 09, 1999, January 20, 2000, and March 28, 2000 and were intended to address initial questions and concerns regarding outreach issues and the TMDL process.

The first public meeting was held on December 9, 1999 in Dayton and was announced in the Virginia Register on November 03, 1999. The second public meeting was announced in the Virginia Register on December 14, 1999. The March 28, 2000, public meeting was announced in the March 13, 2000 Virginia Register and the local. No written comments were submitted by the general public.

8) There is a reasonable assurance that the TMDL can be met.

EPA requires that there be a reasonable assurance that the TMDL can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR 122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit

that is inconsistent with WLAs established for that point source.

Nonpoint source controls to achieve LAs can be implemented through a number of existing programs such as Section 319 of the Clean Water Act, commonly referred to as the Nonpoint Source Program. Additionally, Virginia's Unified Watershed Assessment, an element of the Clean Water Action Plan, could provide assistance in implementing this TMDL.